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(54) **Plastic casing cartridge.**

(57) A cartridge has a one-piece reusable plastic casing that fits over a metal or plastic end cap and holds a bullet. The bullet end of the casing is provided with a ring or a plurality of rings or with a pronounced radially inward taper to engage corresponding surfaces on the bullet so that the bullet may snap into the casing. The bullet end of the casing is radially expansible to allow release of the bullet upon detonation of the powder in the cartridge. The plastic casing is provided with an end cap sealing flange generally being an axially thin, radially inwardly extending flange which fits snugly against the end cap of the cartridge. The flange is thick enough to withstand the high gas pressures upon firing of the powder, but is thin and flexible enough to elastically deform to produce a tight elastic seal against escape of the high-pressure gases around the end cap. The seal may be achieved, also with a thick, rigid flange and a compressible gasket.

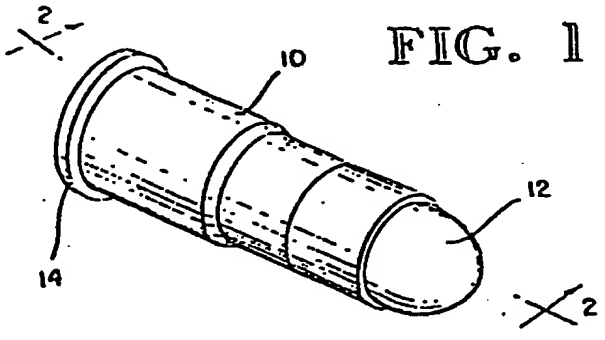

FIG. 1

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Description

PLASTIC CASING CARTRIDGE

Reference to Related Application

This application is a continuation-in-part application of U.S.S.N. 514,245, filed July 15, 1983.

Technical Field

This invention pertains to cartridges, particularly cartridges suitable for handguns.

Background Art

Conventional cartridges for handguns are made with brass casings. The brass casing includes an integrally formed head containing a primer cup for igniting the powder charge at one end, and at the other end is crimped over a bullet or other projectile. Brass casings have the advantage of being reusable. Brass casings have several disadvantages, however. Brass is expensive and requires special tooling to recrimp or reform the bullet end of the casing over the bullet so that it will fit tightly over the bullet.

Due to the high cost and disadvantages of using brass casings, expendable aluminum casings have been developed. The aluminum is less expensive than brass but does not have sufficient elasticity to be reusable. Thus the aluminum casings are fired once and then discarded. The ultimate cost of a discardable aluminum casing is almost as high as that of reusable brass casings. Furthermore, many handgun owners prefer to reload their casings not only to reduce the cost of practice ammunition but also to ensure greater accuracy or quality control of the powder

charge so that there is more accuracy in the flight of the bullet.

Several attempts have been made to develop a reusable plastic casing for handgun cartridges. In the use of plastic casings, it is necessary that there be a tight fit between the casing and the bullet and the casing and the end cap in order to prevent the premature escape of the gases formed when the powder charge is ignited. Th se gases can quickly reach a pressure of over 10,000 psi, and thus the seal around the bullet and the seal around the nd cap of the casing must be tight enough to not allow the escape of the gases until the bullet is discharged. The seal around the end cap is extremely important since any gases which escape at the rear end of the casing will diminish the amount of force available for propelling the bullet and will effect the trajectory of the bullet as w ll as its range and penetration force.

U.S. Patents 4,147,107; 3,990,366, 3,977,326; 3,842,739 and 3,874,294, and German Patent 2,419,881 are examples known to applicant of attempts to make a plastic casing. In order to be price competitive with aluminum or reusable brass, however, the plastic cartridge must be inexpensive to manufacture, easy to reload, and able to withstand the high pressures of powder detonation in order to have a moderate amount of reusability. In the patents above-mentioned, these goals have not been achieved. All of the patents disclose plastic or composite metal and plastic casings which rely on multiple parts to provide the sealing around the end cap or to crimp or hold the casing around the bullet. The cost of producing and assembling a multiple-piece casing is prohibitive, and thus these composite plastic casings have not been successfully marketed.

Disclosure of Invention

It is an object of this invention to provide a plastic casing that includes a separate attached end cap, is reusable, and provides tight seals at the end cap and bullet to prevent the uncontrolled escape of high-pressure gases.

It is another object of this invention to provide a cartridge that holds a bullet during shipping and handling, is easy to reload, is inexpensive to manufacture, and provides excellent sealing characteristics at the end cap and bullet ends of the casing.

Basically, these and other objects are obtained by providing a tubular plastic casing made of a durable but elastic plastic material which allows the bullet end of the casing to radially expand and release the bullet but to elastically return to its original shape for reloading. The opposite end of the casing (for sealing around the end cap) is generally provided with an inwardly extending, relatively axially thin flange or a gasket which snugly engages a corresponding sealing surface of the end cap and which is sufficiently elastically deformable upon firing of the powder so that the flange or gasket forms a resilient seal against the corresponding sealing surface of the end cap to prevent the escape of high-pressure gases. By providing sufficient elastic deformability at the end cap flange of the casing or the gasket, no additional parts are needed to crimp or hold the casing tightly around the end cap. Similarly, by providing sufficient elasticity at the bullet end of the casing, the bullet will be released when the powder is ignited but will not tear or deteriorate the bullet end of the casing after several repeated firings so that it may be reloaded. It is desirable to reach a reloadability of at least four or five times, and in some instances, it is believed that as many as twenty reloads can be made with the unique plastic casing.

Brief Description of the Drawings

Fig. 1 shows a cartridge mploying the principle of the invention.

Fig. 2 is an axial section of one embodiment of the invention.

Fig. 3 is an axial section of another and preferred embodiment of the invention.

Fig. 4 is a detailed fragmentary axial section of a modification of the embodiment shown in Fig. 2.

Fig. 5 is an axial section of another preferred embodiment of the bullet end of the casing.

Fig. 6 is an axial section of another preferred embodiment of the end cap end of the casing.

Fig. 7 is an axial section of another preferred embodiment of the end cap end of the casing.

Best Mode for Carrying Out the Invention

As best shown in Fig. 2, the cartridge includes a casing or case 10, including an end cap 14 containing a conventional primer cup 15 and a bullet 12. The details of the primer cup will not be disclosed, as these are conventional. Essentially, the primer cup has a small anvil. The firing pin of the gun indents the cup along the anvil to ignite a small charge, which in turn ignites the powder charge 16 within the casing. As will be described in more detail below, one unique advantage of this plastic casing is that due to predetermined locations of interlocking rings and grooves the bullet is always seated accurately axially along the length of the casing so that the same volume for powder is created in the casing even after repeated firings. By the use of a repeatedly accurate powder charge, the same gas conditions will exist in the casing so that the bullet always is subjected to substantially equal gas pressures upon repeated firings. This feature provides greater accuracy of the trajectory of the bullet upon firing.

The bullet may be of any material, preferably brass-coat d l ad, and is provided with a radially smaller circumferential outer surface 18 having a pair of axially spaced, inwardly protruding grooves 19. The bullet end 10b of the casing 10 is provided with a thinner wall and a pair of matching, axially spaced rings 20. The thinner wall gives the bullet end of the casing increased flexibility, and with the inherent elasticity of the plastic, allows the bullet end to radially expand upon firing, releasing the bullet and then returning to its original shape for reloading. As is well known in the art the chamber of a handgun is cylindrical as shown in phantom lines c. Thus the stepped bullet end of the casing (Figures 2 and 5) or the tapered end (Figure 3) are free to radially expand to release the bullet. Preferably, the plastic used to ensure the qualities of durability and elasticity is a high-density polyethylene plastic manufactured by DuPont Corporation, having a Young's modulus about 10^{10} dynes/cm^2 and a Poisson's ratio of about 0.3. Other plastics having suitable qualities may also be used.

In the embodiment shown in Fig. 3, the bullet is provided with an inwardly tapering groove 30. In this embodiment, the bullet end of the casing 40b is tapered radially inwardly to seat within the bullet groove 30. An advantage of this type of bullet end of the casing is that while it also expands upon firing, it has no sharp protuberances, such as the rings 20 of the embodiment of Fig. 2, and the bullet is able to escape more smoothly. This results in increased reloadability of the casing.

To increase the accuracy of the bullet, the rings may be of different dimensions, as shown in Fig. 5. There, the ring 22 near the end of the casing has an inside diameter slightly greater than the inside diameter of the inner casing ring 24, so that, when the bullet 12a disengages the rings, the base 13 of the bullet will not contact the end ring 22 as the bullet exits the casing. As shown

in Fig. 5, also, the rings 22 and 24 may have tapered sides, making the rings 22 and 24 annular trap zoidal solids, in effect. The tapered sides strengthen the rings to withstand the violent exiting of the bullet from the casing. Generally, the greater the facing angle opposing exit of the bullet the greater the pressure needed to eject the bullet. While two rings are shown, and are highly preferred, one could use more rings, if desired, for higher pressure, larger caliber cartridges. Those additional grooves may lead to an unbalanced bullet, however.

In both embodiments of Figs. 2 and 3, the end cap end of the casing 10e and 40e, respectively, is provided with an inwardly extending flange 21 having an axial dimension shown by the reference character X. The thickness of this axial dimension is critical, as it must be thick enough to withstand perforating and shearing from the high-pressure gases upon firing of the powder charge but thin enough to allow the flange to flex rearwardly to compress and to form a resilient seal around the radial surfaces of the end cap. In the preferred embodiment for a gas pressure range in a .38 special, this axial thickness is 0.030 inch, although a slight range of from about 0.020-0.040 inch has also been successfully tested. Higher pressure ranges such as for larger caliber cartridge may require a thicker flange. Sealing is believed to reside primarily against the radial surface of the end cap in this configuration, although some sealing may occur also at the axially cylindrical inner surfaces of the end cap. The radial surface is shown by the reference character 24 and the axially cylindrical surface is shown by the reference character 25.

In the embodiment of Fig. 3, the flange 21 has a slight inwardly and axially increasing, curving or straight taper to increase the gas pressure on the cylindrical end surface 25 of the end cap, and to form a crimping surface for a metal end cap 14. In both embodiments of Figs. 2 and

3, the end cap is held ont the casing by slight crimping of the cylindrical surface of the end cap over the flange, as shown by th reference numeral 27. The end cap 14 is a rigid material interlocked to the flange by any other suitable means, such as welding, bonding or mechanically interlocking.

In the modification shown in Fig. 4, for example, a small dimple 28 is provided on the cylindrical end of the end cap so that the casing can be merely snapped over the end cap rather than requiring a crimping tool to attach the end cap to the casing. In all embodiments, it should be understood that the crimp or the dimple does not provide a seal, but rather is merely a mechanical attachment mechanism. The seal against escape of gases, which is critical to accurate firing, is provided by the flexibility and compressibility of the flanges 21 so that they seat tightly against the end cap surfaces.

To reload the bullet into the casing, the bullet end is merely pressed open by the bullet and the bullet pressed rearwardly until it snaps into place. The old end cap is then pressed out and the new end cap replaced and crimped or seated by the dimples 28 into place. Of course, the correct powder charge will precede placement of the bullet into the casing.

As shown in Fig. 6, the seal between the end cap and casing can be achieved with a gasket 34. Here, a thicker flange 32 extends radially inwardly and overlies a flexible gasket 34. When the bullet is ejected, the high pressures within the casing (usually between about 12,000-21,800 psi for a .38 special shell) press the flange 32 against the gasket 34 to achieve the seal by compressing the softer gasket 34 onto the end cap.

Plastics are highly preferred for the sealing flanges or gaskets because they have a much higher bulk compressibility (K) and intrinsic flexibility than metals. The bulk compressibility (K) is inversely proportional to

the Young's modulus of elasticity for the material, according to the formula:

$$K = \frac{3(1-2U)}{E}$$

where U = Poisson's ratio (a measure of the material's tendency to remain a constant volume when stretched). Unoriented polymers, such as high density polyethylene, have a Young's modulus (E) of about one to two orders f magnitude less than metals such as steel or aluminum. The Poisson's ratio for polymers generally is between about 0.3-0.4, while for metals, such as steel or aluminum, it is about 0.4-0.5. Thus, the bulk compressibility (K) (that is, the softness or sponginess) of polymers is far greater than metals. Under pressure, the polymers will tend to seal by elastically deforming on the end cap.

If the flange is too thick, apparently the flange absorbs the pressure internally within the flange material without causing the elastic deformation desirable for sealing at the end cap.

In the embodiment of Fig. 6, the flange 32 must be capable of transmitting the pressure pulse to the gasket 34 to achieve the desired sealing effect. It is usually about 1/16 inch thick.

While the end cap generally has a pillbox shape, it may be possible to construct an end cap having a slightly diverging cylindrical section 36 as shown in Fig. 7. In this embodiment, a corresponding plastic flange 38 on the casing overlies the inner sealing surface 39 of the section 36 and forms a seal on this surface when the cartridge fires. Here, again, the flange 38 is elastically deformable, as described with reference to Figs. 2 and 3. Alternatively, of course, a gasket seal (not shown) could be made.

While the preferred embodiments have been illustrated and described, it will be understood that variations

Claims

1. A cartridge c mprising a separate end cap, a plastic casing having a bullet end and an end cap end, said bullet end having gripping means for engaging and holding a bullet, said end cap end provided with a surface abutting a mating surface on the end cap and having resilient means for sealing with the end cap of a thickness sufficient to transfer the gas pressure to the mating surface of the end cap solely by compressing a portion of said end cap end against the end cap surface due to the pressurized gas from an ignited powder charge, a powder charge, and a bullet seated in the bullet end of the casing.

2. The cartridge of claim 1 wherein the means for sealing includes a radially inwardly extending, axially thin flange for engaging the corresponding mating surface of the end cap, the flange creating the seal with the end cap surface when under pressure of a fired cartridge.

3. The cartridge of claim 1, said flange b ing between about 0.020-0.040 inch in axial thickness.

4. The cartridge of claim 1, said bullet end of said casing having a pair of axially spaced, radially inwardly extending rings, said bullet having a rear radially recess d circumferential surface provided with a pair of corresponding axially spaced grooves, said rings being seated within said grooves to hold the bullet in said casing, said bullet end of said casing having a radially smaller external wall diameter than said end cap end of said casing, so that the bullet end of the casing can radially elastically expand to release the bullet upon firing and return to its contracted position for reloading.

5. The cartridge of claim 4 wh rein the ring nearer the bullet end terminus of the casing has a larger inside

diam ter than the ring farther from the bullet end terminus of th casing for allowing more accurate jection of the bullet from the casing.

6. The cartridge of claim 1, said bullet having a rearward circumferential surface tapering axially and radially inward to form a casing seat, said bullet end of said casing having a radially inwardly tapering wall for seating on said bullet seat, so that the casing bullet end can elastically expand upon firing to release the bullet and then return to its tapered condition for reloading.

7. The cartridge of claim 2 wherein the end cap surface is a radial surface, said end cap also having an axial cylindrical surface, and wherein said flange abuts both said radial surface and said cylindrical surface.

8. A re-loadable tubular plastic casing for use in a reloadable pistol cartridge to be fired in a cylindrical pistol chamber, comprising:

an end cap end for receiving a powder ignition device;

a bullet end;

a central portion joining the ends;

said bullet end being radially, elastically expansible so that the bullet end can expand to receive a bullet during reloading and to release a bullet during firing, the bullet end returning substantially to its original shape following release of the bullet, thereby allowing reloading of the bullet, the bullet end having a smaller external diameter than the central portion of the casing, the smaller diameter allowing radial expansion toward the wall of the cylindrical pistol chamber when the cartridge is fired.

9. The casing of claim 8 wherein the wall thickness of the bullet end is thinner than that of the central portion

to enhance th outward radial expansi n of the bull t end up n firing.

10. The casing of claim 9 wherein the bullet end includes two internal circumferential rings for engaging matching grooves on the bullet.

11. The casing of claim 10 wherein the inside diameter of the rings is different, with the ring nearer a discharge end of the bullet end having a larger inside diameter than the other ring.

12. The casing of claim 8 wherein the inside and outside diameters of the bullet end decrease gradually and the casing, accordingly, tapers inwardly toward a discharge end of the casing.

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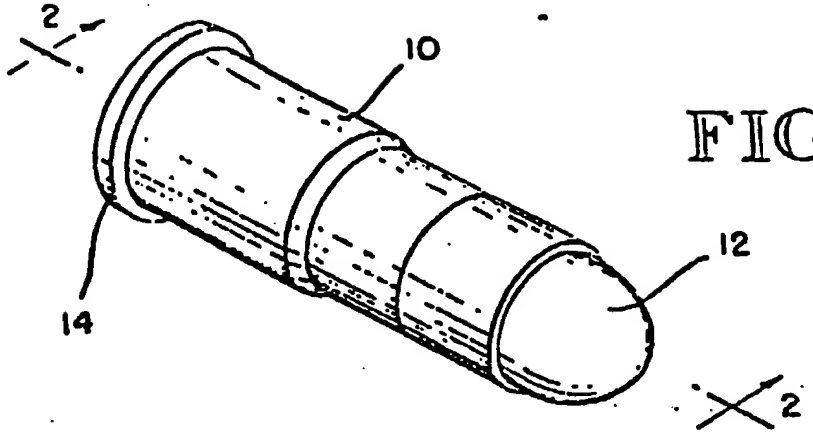

FIG. 1

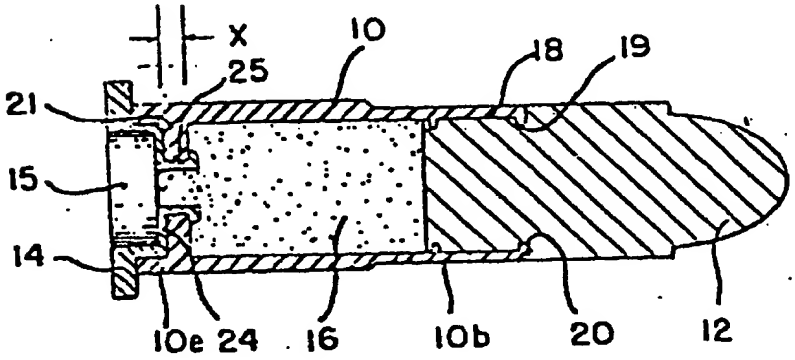

FIG. 2

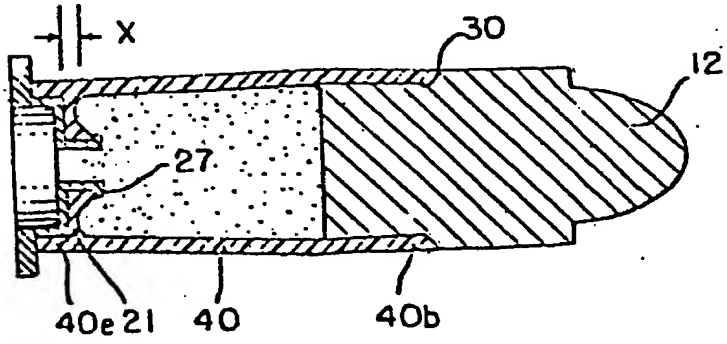

FIG. 3

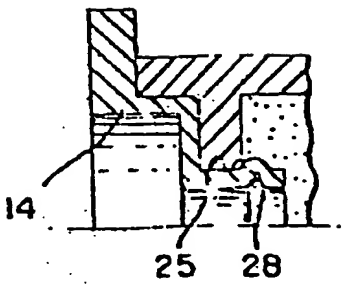

FIG 4

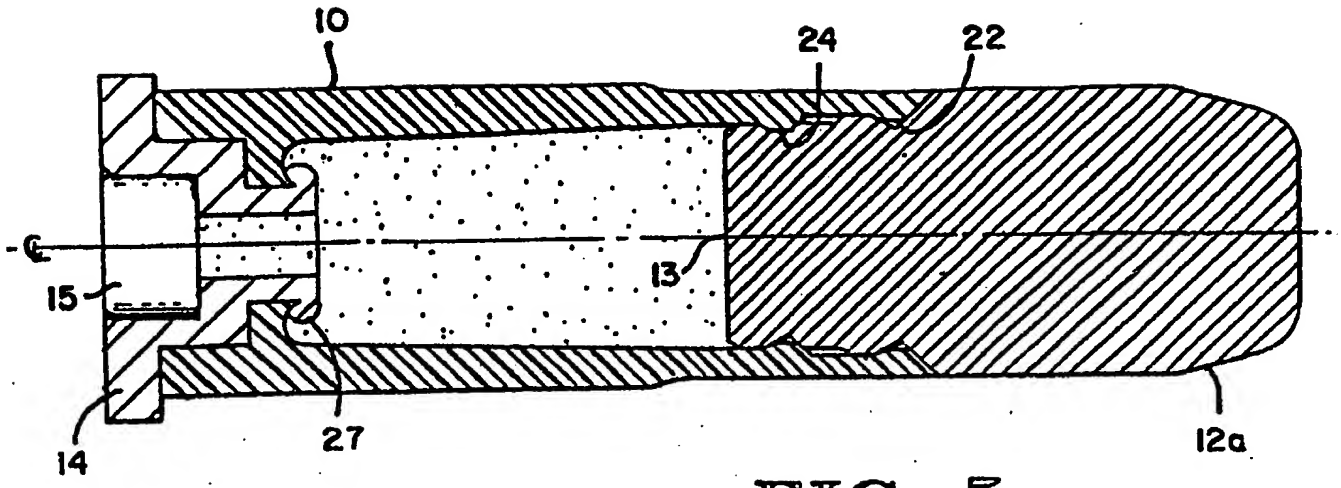

FIG. 5

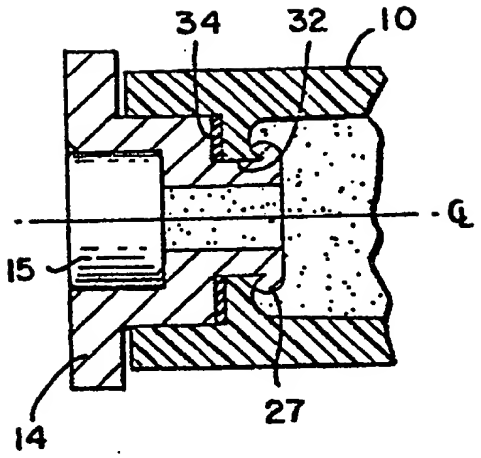

FIG. 6

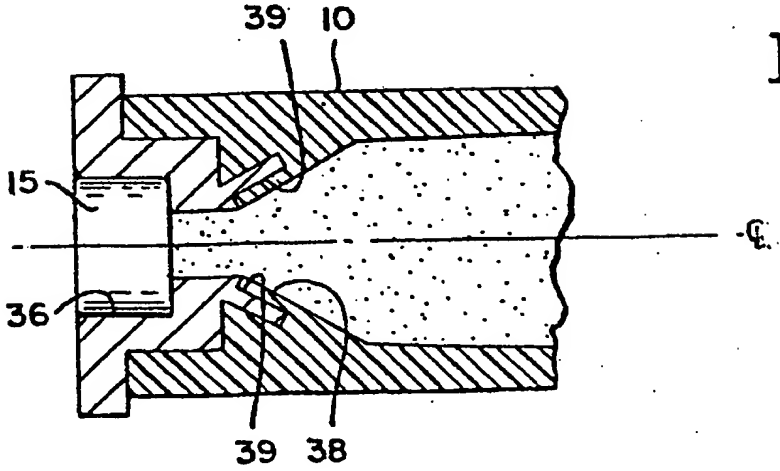

FIG. 7